

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

MANURE TRANSFER

(No.)
CODE 634

DEFINITION

A manure conveyance system using structures, conduits, or equipment.

PURPOSE

To transfer animal manure (including bedding material, spilled feed, process and wash water, and other residues associated with animal production) through a hopper or reception pit, a pump (if needed), and a conduit to a manure storage/treatment facility or loading area, or from storage/treatment to agricultural land for final utilization. This includes application of manure to the utilization area.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- the manure transfer component is a part of an overall planned agricultural waste management system.
- manure is generated by livestock production or processing.
- a conveyance system is needed to move agricultural waste to facilitate farm management and minimize contamination threats to surface and ground water.
- the equipment, labor, and other resources are available to operate, manage, and maintain the system.
- Soils, geology, and topography are suitable for construction.

CRITERIA

General

Manure transfer components shall comply with all federal, state and local laws, rules and regulations.

Reception pits, hoppers, pumps, structures, and pipelines shall be located a minimum of 50 feet

from a well, spring, or reservoir. The lowest point of a reception pit, hopper, or structure shall be one foot or more above bedrock and seasonal high water table.

Structures

All structures, including those that provide a work area around pumps will be designed to withstand the anticipated static and dynamic loading. The structure shall withstand earth and hydrostatic loading in accordance with Practice Standard 313, Waste Storage Facility. The minimum thickness of component elements of concrete structures shall also be in accordance with Practice Standard 313. When needed, covers shall be designed to support the anticipated dead and live loads.

Gravity Manure Transfer

1. **Gravity Drop Structure** - A gravity drop structure is a vertical chute or hopper which conveys waste into a large diameter transfer pipe. The structure shall be constructed of durable, corrosion-resistant material, and be liquid tight. The structure shall be designed to withstand all anticipated static, hydrostatic, dynamic, and earth loads in accordance with Practice Standard 313 - Waste Storage Facility. Pre-cast concrete structures shall comply with ASTM C-478 Precast Reinforced Concrete Manhole Sections.

The volume of the gravity drop structure above the maximum effective storage elevation of the waste storage facility (top of storage minus freeboard) shall be at least the anticipated daily volume of manure produced. When manure is scraped with a front end loader or an alley scraper system, a grate to provide the necessary opening for manure flow into the structure shall be provided. The inlet or loading opening to the drop structure shall be compatible with the

scraping and cleaning equipment. The maximum slot width between the grates shall be six inches. The minimum area of the grate is nine square feet with at least one dimension no smaller than four feet. The grate shall support the anticipated loads.

A cover that will support the anticipated live and dead loads and provide safety for animals and/or humans shall be provided for the drop structure. Permanent barriers such as gates, fences, etc., may be installed in lieu of a cover if such barriers ensure adequate safety for human and animal traffic.

The drop structure inlet shall be flush with or slightly lower than the barn floor level.

Curbing, which is at least 12 inches high and constructed of concrete, wood, or other durable materials, may be installed across from the loading side of the grate to ensure total manure flow into the drop structure. The curbing must be adequately anchored and designed against over turning forces by the scraping equipment.

The top of the drop structure shall be a minimum of five feet above the effective top elevation of the waste storage facility (top of storage minus freeboard) when the gravity transfer pipe length is less than 100 feet. The top of the drop structure shall be a minimum of six feet above the effective top elevation of the waste storage facility when the gravity transfer pipe length is greater than 100 feet. The drop structure inlet shall be a minimum of four feet above the top of the transfer pipe inlet.

The outlet of the drop structure shall be constructed to minimize the head loss at the inlet of the transfer pipe. The floor of the drop structure shall slope in the direction of the outlet to provide a smooth transition from the drop structure into the conduit. A minimum slope of 30 percent (approximately 1 vertical to 3 horizontal) is suggested. Fillets to reduce sharp corners and significant losses at the pipe inlet are recommended.

The drop structure should be located in the building or enclosed to minimize freezing and drying problems. The area around the drop structure may have to be heated during cold weather to prevent manure from freezing.

2. **Gravity Transfer Pipes** - A gravity transfer pipe is a conduit used to transfer manure and liquid waste by gravity from the source to a waste storage facility. Pipelines shall be designed to have a minimum of 2 feet per second and a maximum of 6 feet per second velocity except where ruminant manure is transferred in a gravity system, in which case velocities may be reduced if a minimum of 5 feet of head is provided on the pipe system, measured above the effective top elevation of the storage facility (top of storage minus freeboard). The minimum pipeline capacity from collection facilities to storage/treatment facilities shall be the maximum flow anticipated on a daily basis.

The pipe must meet or exceed the requirements of the applicable specification as follows:

<u>Pipe Material</u>	<u>Specification</u>
Polyvinyl Chloride (PVC)	ASTM D3033, ASTM D3034 ASTM F679
Reinforced Concrete	ASTM C76
Steel	ASTM A53 ASTM A134 ASTM A135 ASTM A139

All transfer pipes must be installed with watertight couplings. Gaskets shall be the types recommended by the pipe manufacturer for watertight conditions. Steel pipe without bell and spigot ends shall be welded. Corrugated pipe shall not be used.

All pipes must withstand the earth, live load, and dead load pressures. The minimum earth cover over the pipe shall be four feet or insulation provided to protect against freezing. The minimum internal pressure rating of the pipe shall be five times the maximum anticipated head.

Clean out access shall be provided for gravity pipelines at a maximum interval of 200 feet for lines carrying non-bedded manure, and 150 feet for bedded manure. Gravity pipelines shall not have horizontal curves or bends except minor deflections (less than 10 degrees) in the pipe

joints unless special design considerations are used.

- **Gravity pipes for dairy manure** - For dairy manure, the maximum pipe length shall be 250 feet for manure with no bedding. For manure with up to 2 to 3 pounds per day per head of short hay, short straw, or sawdust bedding the maximum pipe length shall be 150 feet. Gravity flow pipe systems are not recommended for manure with long hay bedding, sand bedding, or with bedding in excess of 3 pounds per day per head.

Where possible, the gravity pipe shall be installed on five percent slope or flatter. The maximum length of the pipe shall be 200 feet if gravity pipes are installed on slopes steeper than five percent. The maximum pipe slope shall be 12 percent.

The outlet end of the pipe shall have sufficient cover of manure to prevent freezing during cold weather. The end section of the pipe shall be sufficiently anchored to prevent flotation or movement of the section into the storage facility. A headwall or deadman anchors may be required.

The minimum pipe diameters for pipe lengths of 100 feet or less are as follows. For lengths greater than 100 feet, increase the head by 3 ft or the diameter by six inches for each 50 feet of additional length:

Minimum Head ¹	Bedding ²	Pipe Diameter	
		Concrete	PVC/Steel
(ft)	(lb/day/hd)	(in)	(in)
5	None	24	18
	2 – 3	30	24
6	None	21	15
	2 – 3	27	21

¹ Head is the elevation difference from the inlet of the hopper or drop structure to the effective top of storage of the waste storage facility (top of storage minus freeboard).

² Three pounds per day per head of sawdust, chapped or short hay or straw is the maximum amount of bedding to be used. Long hay or straw bedding does not flow. Sand bedding is allowed only if provisions are made for complete clean out of the waste storage facility, including the sand at the outlet end of the gravity pipe.

- **Gravity pipes for swine or veal manure** – For swine and veal manure with no bedding, a flush-type system is recommended to prevent the build up of solids. The minimum diameter pipe shall be 6 inches for pipe slopes greater than 1 percent, and 10 inches for pipe slopes between 0.5 and 1 percent. The minimum pipe diameter for scraper type systems shall be 12 inches. The maximum pipe grade shall be 10 percent.
- **Gravity pipes for milkhouse and parlor waste water** – For milkhouse and parlor waste water, the minimum pipe diameter shall be 4 inches for pipe slopes greater than 1 percent, and 6 inches for slopes between 0.5 and 1 percent. A settling tank (grease trap) shall be considered for parlor systems to settle solids. Undulations in the pipe grade shall be kept to a minimum.

Gravity milkhouse and parlor waste water pipelines that outlet directly to a waste storage facility shall outlet above the maximum effective storage elevation of the storage facility.

3. **Milkhouse waste water siphon station** – A siphon station is a tank, siphon, transfer pipe, and other appurtenances used to collect milkhouse and parlor waste water and transfer to a treatment system. The siphon allows the transfer of waste water to dose the treatment area intermittently, allowing the area to rest.

A septic tank/grease trap is required for all siphon stations to exclude solids.

The dosing tank, transfer pipe, and siphon shall be sized to accommodate the flow rate and time between doses required for the treatment area, and shall meet the requirements of the siphon manufacturer. Refer to the appropriate Practice Standard for the treatment area to determine the interval between doses.

The dosing tank and siphon shall be installed according to the manufacturer for proper functioning of the siphon.

The transfer pipe shall be installed below frost elevation unless provisions are made to allow the water to drain freely from the pipe after each dosing.

4. **Other Conduits** – Concrete lined ditches shall be designed in accordance with Practice Standard 428A, Irrigation Water Conveyance, Non-reinforced Concrete Ditch and Canal Lining. A minimum design velocity of 1.5 feet per second shall be used.
5. **Gravity Outlet Pipes** – a gravity outlet pipe is a conduit used to convey manure from the waste storage facility to a spreader or hauling unit. Each site will be evaluated for the potential downstream water quality impacts due to an accidental release of manure from a structure with a gravity outlet pipe.

The pipe shall be welded steel with a minimum pipe size of 18 inches.

The bottom of the waste storage facility shall be sloped a minimum of 2 percent toward the inlet of the gravity outlet pipe. An additional depression of one foot is also recommended.

The minimum head (bottom of storage facility to invert of outlet end) shall be four feet. The outlet pipe shall have a minimum slope of 4 percent.

Two shut-off valves shall be installed on the pipe: one at the outlet end and one located below the frost line. The valves shall be operated by two independent power sources, i.e., one manual and one hydraulic, or one hydraulic operated by an electric motor and one hydraulic operated by a tractor. The valves shall be dual acting, capable of applying pressure in both directions.

The end section of the outlet pipe shall be designed to support the anticipated loadings. The outlet end of the pipe shall be high enough to load the hauling equipment, but in no case shall it be less than 8 feet above the loading platform. The loading platform shall support any anticipated hauling equipment.

A containment facility shall be provided for spillage during normal unloading operations. The volume of the containment facility shall be at least twice the volume of the largest hauling equipment used at the farm. A pipe with a shut-off valve shall be provided to drain the containment area when not in use.

Pumped Manure Transfer

1. **Reception pits** – A reception pit is a temporary storage facility that typically stores manure for 3 to 14 days. The manure is generally transferred to the waste storage facility by means of a PTO or electric pump. The hopper or reception pit size and dimensions shall be as recommended by the manure pump manufacturer.

Reception pits shall be designed and installed in accordance with Practice Standard 313, Waste Storage Facility. Openings in the top or side of the reception pit shall be sized and designed to accommodate both manure loading and unloading systems. Covers, grates, fences, or other protective devices shall be installed over or around the reception pit openings.

2. **Manure pumps** – The manure pump provides mechanical energy to move manure or other waste water through a transfer pipe to a waste storage facility. Pumps installed for manure transfer shall meet the requirements of Practice Standard 533, Pumping Plant for Water Control. Pumps shall be sized to transfer manure at required system head and volume.

The outlet from the pump shall provide a smooth transition to the transfer pipe.

The type and size of pump shall be appropriate for the consistency of the manure and waste water, and shall be installed as recommended by the manufacturer.

Pumps and their appurtenances shall be enclosed to protect against rain and cold weather. The enclosure may also have to be heated to protect equipment from freezing.

3. **Transfer pipe for pumped manure** – The pipe used to transfer manure from a pump to a reception pit or waste storage facility shall have watertight couplings.

The size, type, strength, and pressure rating of the pipe shall meet or exceed the pump manufacturer's recommendations.

In all systems where the top of the reception pit is below the maximum operating level of the waste storage facility, manually operated valves or other devices recommended by the pump manufacturer shall be installed to prevent the reverse of flow of manure which would result in a discharge.

4. **Milkhouse waste water pump station** – A pump station is a tank, pump, transfer pipe, and other appurtenances used to collect milkhouse and parlor waste water and transfer to a storage facility or treatment facility.

A septic tank/grease trap shall be installed ahead of the pump station on all parlor systems.

The pump tank volume shall be sized to accommodate the remaining system. For example, the pump tank for waste water pumped to a treatment facility will allow for resting of the treatment facility between applications. Refer to the appropriate practice standard for the treatment facility being designed to determine the interval between applications. Also, pipeline backflow must be considered when sizing the pump tank, unless a check valve is installed.

The pipe shall be a minimum of 2 inches in diameter and shall resist the anticipated internal and external pressures.

The pump shall be submersible and capable of handling 1-½ inch solids. Pumps and appurtenances shall be installed in accordance to the manufacturer's recommendations. Pumps shall be capable of being turned on and off by both float and manual switches. Pumps shall be installed to allow for easy access for maintenance and repair.

Transfer pipe shall be installed below frost elevation unless provisions are made to allow the water to drain freely from the pipe after each pumping event.

5. **Irrigation of manure and waste water** – Irrigation of waste water includes pumping from the storage facility or reception pit to the field or filter area where it is applied to the land

by sprinklers. Sprinkler applied waste water shall contain a maximum of 2 percent solids.

Pumps installed for waste water transfer to an irrigation system shall be designed in accordance with Practice Standard 533, Pumping Plant for Water Control. Sprinklers or sprinkler systems shall be designed in accordance with Practice Standard 442, Irrigation System, Sprinkler. Permanently installed mains and laterals shall meet the requirements for Practice Standard 430, Irrigation Water Conveyance. The system design capacity shall be adequate to apply the required volume of manure, however, the application rate and uniformity of waste water shall not exceed the infiltration capacity and nutrient requirements of the soil and vegetation.

Safety

The system design shall consider the safety of human and animals during construction and operation.

Open structures shall be provided with covers or barriers such as gates, fences, etc. Ventilation and warning signs shall be provided for manure transfer systems as necessary to warn of the danger of entry and to reduce the risk of explosion, poisoning, or asphyxiation.

Pipelines from enclosed buildings shall be provided with a water-sealed trap and vent or similar device where necessary to control gas entry into buildings.

Tractors or other vehicles used to tow manure spreaders or tank wagons shall be sized to reduce the danger of roll-over.

Land Application and Utilization

Manure shall be applied to the utilization area in amounts and at a time consistent with the manure management plan and Practice Standard 633, Waste Utilization.

Manure spreaders and/or tank wagons shall have adequate capacity to ensure the emptying of storage facilities within appropriate time periods as stated in the system operation and maintenance plan.

Gated pipe and other appurtenances used in conjunction with gravity applications to treatment

areas shall be designed to ensure uniform application amounts.

CONSIDERATIONS

The final consistency of the manure product determines the best methodology and equipment needed to transfer the material. The final consistency of the combined manure should be estimated prior to selecting and designing transfer components.

Collection structures should be located as close to the source of manure as possible.

Combine manure at centralized collection points to minimize the number of manure transfer components required when manure is being transferred to a common end point.

An existing collection system should be evaluated to determine if it will function with the planned and designed manure transfer components, the expected manure consistency, and type of housing to be used.

Unless special provisions are made, the use of sand as animal bedding should be avoided with gravity flow transfer.

Consider discharging liquid wastes such as milkhouse or parlor waste water, silage leachate, and barnyard runoff into the reception pit or gravity drop structure to provide a more liquid consistency and improved flow conditions in the transfer pipe.

At least one conveniently located stable unloading area should be provided for trailer or tractor mounted power take-off pumps used for agitating and emptying a waste storage facility.

Utilize topography to generate head to reduce pumping requirements.

Consider sanitation needs of all conveyance equipment that leaves the farm in order to prevent the spread of disease.

Consider the potential for salt (struvite) deposits in smaller diameter pipe.

Refer to the collection and transfer sections of Chapter 10 of the Agricultural Waste Management Field Handbook for additional considerations.

PLANS AND SPECIFICATIONS

Plans and specifications for installing manure transfer systems shall be in accordance with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

Operation and maintenance shall be in accordance with the requirements specified in the overall operation and maintenance plan required by Practice Standard 313, Waste Storage Facility.

The protective cover or barrier for the hopper or drop structure inlet shall be maintained to provide safety for animal and human traffic. The cover or barrier shall be reinstalled immediately after each cleaning.

Frozen and dried manure can plug manure transfer components and should be handled separately. Frozen manure should be piled or stacked until thawed before loading into the transfer system. Dried manure should have water added or be mixed with wetter manure before loading into the transfer system.

Shields and other safety devices on manure pumps and other equipment shall be installed and maintained.

Care should be exercised by equipment operators when loading and unloading to prevent damage to the system. Any damage to the system should be repaired as soon as practical.

The landowner should train all persons involved in the operation of a gravity outlet system. All control valves shall be closed at the end of each day.

REFERENCES

Agricultural Waste Management Field Handbook. National Engineering Handbook, Part 651, USDA-NRCS.

Chapter 2 – Planning Considerations
Chapter 4 – Waste Characteristics
Chapter 9 – AWM Systems
Chapter 10 – Component Design
Chapter 11 – Waste Utilization
Chapter 12 – Equipment

Dairy Practice Council, Guideline for Dairy Manure Management from Barn to Storage, DPC 27. Northeast Regional Agricultural Engineering Service (NRAES-108), 1998.

Dairy Practice Council, Guideline for Milking Center Wastewater, DPC 15. Northeast Regional Agricultural Engineering Service (NRAES-115), 1998.

Livestock Waste Facilities Handbook. Midwest Plan Service, MWPS-18, 1985.

Structures and Environment Handbook, MWPS-1, Midwest Plan Service, 1987.